

CLAIMS

The invention claimed is:

1. A medical device having a surface, said surface defining a surface layer substantially comprising chromium nitride.
2. The medical device of claim 1 wherein said surface layer has a depth measured from said surface, said depth being greater than 3 microns.
3. The medical device of claim 1 wherein said surface layer has a depth measured from said surface, said depth being less than 15 microns.
4. The medical device of claim 1 further comprising a transition layer adjacent to said surface layer, said transition layer having a depth less than a depth of said surface layer.
5. The medical device of claim 1 wherein said surface is a load bearing surface.
6. An implantable medical device comprising:
 - (a) a first surface comprising one of a metal, a polymer, a ceramic, and a bone; and
 - (b) a body comprising cobalt and chromium, said body having a second surface arranged for movable contact with said first surface, said second surface defining a surface layer substantially comprising chromium nitride.
7. The medical device of claim 6 wherein said surface layer has a depth measured from said second surface, said depth being greater than 3 microns.
8. The medical device of claim 6 wherein said surface layer has a depth measured from said second surface, said depth being less than 15 microns.
9. The medical device of claim 6 further comprising a transition layer adjacent to said surface layer, said transition layer having a depth less than a depth of said surface layer.

10. The implantable medical device of claim 6 wherein said body further comprises molybdenum.
11. The implantable medical device of claim 6 wherein said body comprises an alloy of cobalt and chromium conforming to one of an ASTM-75 standard specification, an ASTM-F-75 Modified standard specification, and an ASTM-799 standard specification.
12. A medical device comprising a body comprising cobalt and chromium, said body including a surface exposed to a gas including nitrogen at a pressure less than one atmosphere and a temperature within a range of 250°C to 1000°C for a time sufficient to form a surface layer defined by said surface, said surface layer comprising substantially chromium nitride.
13. The medical device of claim 12 wherein said surface layer has a depth measured from said surface, said depth being greater than 3 microns.
14. The medical device of claim 12 wherein said surface layer has a depth measured from said surface, said depth being less than 15 microns.
15. The medical device of claim 12 further comprising a transition layer adjacent to said surface layer, said transition layer having a depth less than a depth of said surface layer.
16. The medical device of claim 12 wherein said body further comprises molybdenum.
17. The medical device of claim 12 wherein said body comprises an alloy of cobalt and chromium conforming to one of an ASTM-75 standard specification, an ASTM-F-75 Modified standard specification, and an ASTM-799 standard specification.
18. The medical device of claim 12 wherein said gas further comprises at least one of hydrogen, argon, and methane.

19. The medical device of claim 12 wherein said temperature within said range of 250°C to 1000°C comprises a temperature within a range of 450°C to 600°C.
20. The medical device of claim 12 wherein said pressure less than one atmosphere comprises a pressure less than 100 millibars.
21. The medical device of claim 12 wherein said pressure less than one atmosphere comprises a pressure less than 5 millibars.
22. The medical device of claim 21 wherein said pressure less than one atmosphere comprises a pressure greater than 1 millibar.
24. The medical device of claim 12 wherein said time sufficient to form said surface layer comprises a period longer than 8 hours and shorter than 42 hours.
25. A medical device having a surface, said medical device comprising:
 - (a) a matrix comprising cobalt, chromium and molybdenum; and
 - (b) a surface layer defined by said surface, said surface layer comprising substantially chromium nitride and having a depth from said surface of at least 3 microns.
26. The medical device of claim 25 wherein said surface layer is produced by a process comprising the steps of:
 - (a) exposing said surface to a first stage plasma for a first period of at least two hours, said first stage plasma being produced by exposing a first stage gas comprising less than 10 percent nitrogen and at least 90 percent hydrogen to an electrical pulse having a first stage voltage, said first stage gas having a pressure less than one atmosphere and a temperature within a range of 450°C to 600°C; and
 - (b) exposing said surface to a second stage plasma for a second period, said second period being at least fourteen hours in length and subsequent to said first period, said second stage plasma being produced by exposing a gas comprising a greater percentage of nitrogen than that of said first stage gas to an electrical pulse having a second stage voltage, said second stage voltage being less than said

first stage voltage, said second stage gas having a pressure less than one atmosphere and a temperature within a range of 450°C to 600°C.